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WASTE MINIMIZATION EFFORTS - AN OVERVIEW OF THE U.S. EPA POLLUTION PREVENTION RESEARCH PROGRAM

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To be presented at the GRCDA 28th Annual
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16. ABSTRACT

This paper is to be presented at the Governmental Refuse, Collection, and Disposal Association's 28 Annual Internation Solid Waste Exposition in Vancouver, B.C., Canada, August 20-24, 1990. The paper's purpose is to describe the current pollution prevention research program assigned to the Risk Reduction Engineering Laboratory which incorporated multi-media direction in providing practical solutions to the complex problems of waste management. The pollution prevention research program follows the six fundamental goals identified in the Pollution Prevention Research Plan: Report to Congress. The six research goal areas are: products, processes, recycling and reuse, socio-economics and institutions, anticipatory; and technology transfer. Municipal solid waste research is described for the source reduction and recycling projects planned and currently in progress. The future of pollution prevention research is described in several EPA documents as a major focus for the Agency. This paper will be published in the conference proceedings.

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"WASTE MINIMIZATION EFFORTS - AN OVERVIEW OF THE U.S. EPA POLLUTION PREVENTION RESEARCH PROGRAM"

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INTRODUCTION

Since 1988, the U.S. EPA has supported a formal research program to encourage the development and demonstration of techniques and technologies for reducing the generation of pollution. The concept of "pollution prevention" is not new and continues to provide practical solutions to the complex problems of waste management. Pollution prevention is a term that describes approaches to environmental improvement that involves eliminating or reducing the quantity and/or toxicity of pollutants rather than treating pollutants for safer disposal. No longer can researchers be satisfied with providing support for regulations on pollution limits and control technologies without focusing their efforts on research to avoid producing the waste. When Congress declared a national policy on waste minimization as part of the 1984 Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act (RCRA), we all had to realize the importance of pollution prevention to the well-being of our environment. A formal response to the EPA Administrator from the Science Advisory Board (SAB) entitled "Future Risk: Research Strategies for the 1990's" recommends that EPA shift the center of its environmental protection strategy from end-of-pipe control technology to pollution prevention. To date, the Agency administers many federal environmental laws to reduce pollution problems after the pollution has been generated. The change in focus attacks the pollution problem at the origin without regulatory inducements and requires increased efforts in pollution prevention research, development and demonstration (RD&D) to support this new direction. The purpose of this paper is to describe the current pollution prevention research program assigned to the Risk Reduction Engineering Laboratory which incorporates multi-media direction in providing practical solutions to the complex problems of waste management.

POLLUTION PREVENTION RESEARCH PROGRAM GOALS

The Pollution Prevention Research Plan: Report to Congress is the foundation for the current and future pollution prevention research program within the Agency. The plan builds on past and current EPA pollution prevention efforts and identifies six research goals for the Agency's Pollution Prevention Research Program. The six fundamental goals of the research program are to:

1. **Stimulate private sector development and use of products that result in reduced pollution.**

2. **Stimulate private sector development and implementation of technologies and processes that result in reduced pollution.**

3. **Expand the reusability and recyclability of wastes and products and the demand for recycled materials.**

4. **Identify and promote the implementation of effective socioeconomic and institutional approaches to pollution prevention.**

5. **Establish a program of research that will anticipate and address future environmental problems and pollution prevention opportunities.**

6. **Conduct a vigorous technology transfer assistance program that facilitates pollution prevention strategies and technologies.**

The Pollution Prevention Research Branch is meeting these goals through a structured research program that covers the six major areas of: products research, processes research, recycling and reuse research, socioeconomic and institutional research, anticipatory research, and technology transfer and technical assistance. While each research program area corresponds to a specific research goal, there are many cross-cutting issues and multiple objectives within the research program areas that support the achievement of other research goals. The Pollution Prevention Research Plan: Report to Congress (EPA/600/9-90/015) may be obtained at no charge from EPA's Center for Environmental Research Information, 26 West Martin Luther King Drive, Cincinnati, Ohio 45268.

CURRENT ACTIVITIES

Products Research Program

All products are potential pollutants at one or more stages of their life cycle, and it is necessary that pollution impacts associated with products be reduced. The current research projects in the Products Research Program focus on products and their pollution burdens throughout the product's life cycle and not on just one stage of the cycle such as design, manufacturing (processing), or packaging.

Several projects are in place to support research in the area of clean product research. A background document on clean products research and implementation has been prepared at the request of EPA to provide background information on the current state of research activities on the subject products, and to identify issues that must be resolved as programs are implemented. Through the University of Tennessee, EPA is conducting a "safe substitutes" study to identify environmentally "safe" products based on product, packaging, and process for several product categories. The first year effort of this study is devoted to high profile products that are likely to enter the municipal solid waste (MSW) stream. A clean products case studies project conducted with INFORM, Inc. is designed to produce several documents of various companies involved in developing programs to produce and market products that might be categorized as "clean" products.

A cooperative effort involving several EPA offices as well as other groups representing industry and environmental interests proposes to prevent pollution at the pre-production stage by reducing market demand for consumer

products entailing "risk" to human health and the environment. A final product of this project will be a guide for consumers and producers describing the product group, a scoring process, cost information and risks associated with alternative products.

Research guidance and direction will result from a product life cycle analysis (PLA) workshop with producers of several well known consumer products. EPA feels that an approach to the Clean Products Research Program should be the sponsorship of several specialized product workshops to receive input from industry, consumers, government, and others to better understand and identify research needs. In addition to these projects, a cooperative agreement with the University of Michigan is being developed to produce a guidance manual for industry on determining product design changes.

Processes Research Program

The Processes Research Program area includes developing and demonstrating innovative engineering and scientific technologies and techniques to reduce the volume of waste produced and the toxicity of wastes generated from the manufacture, processing, and use of materials. As with products, all processes are potential areas of waste generation. These processes include the operations associated with agriculture, mining, construction, manufacturing, transportation, wholesale and retail trade, and service industries.

Many of the projects for this research program area are part of the Waste Reduction Innovative Technology Evaluation (WRITE) Program which was established to promote a national pollution prevention policy by forming research partnerships with EPA, industry, State and local governments and academia in an effort to encourage the development and/or demonstration of effective technologies for waste reduction. The WRITE Pilot Program, with State and local governments, addresses immediate information needs between government and industry. Initial participants in this program are: California; Connecticut; Erie County, New York; Illinois; Minnesota; New Jersey; and Washington.

An example of the WRITE Program is the Washington WRITE Project whereby five pollution prevention technologies are being evaluated that are either implemented at full-scale at the present time or are to be implemented within the time frame of this three year study. An example technology involves the recycling of acetone still bottoms and the substitution of water-based cleaners for acetone with the objective of eliminating such RCRA wastes. Wastes of this type are generated by a large number of relatively small fabrication shops in the State of Washington and across North America. The Washington Department of Ecology has arranged for this study to include an evaluation at a fiberglass boat manufacturer and at a company that makes bathtubs, shower stalls, and spas. This technology evaluation will provide data on the environmental, technical, and economic effects on the recycling of still bottoms, drying, grinding, and reformulating the product into a resin filler putty that was previously made from virgin material.

Another part of the Processes Research Program is the development and use of "The Waste Minimization Opportunity Assessment Manual", EPA/625/7-88/003, that was prepared for individuals who are responsible for planning, managing, and implementing waste minimization activities at waste generating sites and facilities. This Manual assists waste generators in seeking opportunities to reduce the generation of hazardous and non-hazardous wastes by conducting waste minimization assessments within the operations of a facility. The Processes Research Program has supported and continues to support several projects to demonstrate the use of the Manual. Copies of this manual may be obtained at no charge from EPA's Center for Environmental Research Information, 26 West Martin Luther King Drive, Cincinnati, Ohio 45268.

Through a cooperative agreement with the New Jersey Department of Environmental Protection (NJDEP), EPA is using the Manual to conduct waste minimization assessments at thirty New Jersey companies across ten industry segments. The waste minimization assessments portion of the Processes Research Program will be primarily supported in the next two years through a cooperative agreement with the University City Science Center (UCSC). Assessment teams composed of faculty and students have been established at the University of Tennessee (Knoxville), Colorado State University (Fort Collins), and the University of Louisville under the direction of the UCSC will initiate waste minimization assessments at small and medium-sized businesses which lack the in-house capability for initiating waste minimization programs. In addition, EPA has published a series of industry-specific waste minimization guidance manuals in cooperation with the California Department of Health Services. Seven manuals are available for the following industries: paint formulators, pesticides, commercial printing, metal fabricators, circuit board manufacturing, hospitals, and research and educational institutions. A second set of eleven manuals are being prepared.

EPA provides support to other federal activities through the Waste Reduction Evaluations At Federal Sites (WREAFS) Program was designed to encourages the participation of other Federal agencies in pollution prevention research and demonstration projects. This popular program has on-going projects with results being transferred to both the private and public sectors. The three major objectives of the WREAFS Program are to 1) conduct waste minimization assessments and case studies; 2) conduct research and demonstration projects jointly with other Federal activities; and 3) provide technology and information transfer of pollution prevention results.

Waste minimization opportunity assessments have been conducted at the Philadelphia Navy Shipyard, Army Forces Command - Ft. Riley (Kansas), Naval Undersea Warfare Engineering Station - Keyport (Washington), and the Veteran Affairs Medical Center - Cincinnati (Ohio). Assessments are on-going at the US Coast Guard's Governor's Island Facility and other facilities. A major waste minimization research program is in the planning stages with the Department of Energy as a research agenda is being prepared under a Memorandum of Understanding (MOU) for approval by DOE and EPA. A cooperative EPA Region 10 workshop for technology transfer within the Federal Community is being planned for later this year. As the concept of pollution prevention is rapidly being embraced throughout industry and government, the need for RD&D and the WREAFS Program becomes increasingly more popular within the Federal community.

Recycling and Reuse Research

Research for recycling and reuse requires more than finding innovative separation and collection techniques for post-consumer materials. As earlier discussed in the research areas for products and processes, recycling and reuse research begins with the design of a product and the technique is carried through the manufacturing of a product with recycle/reuse as part of the process and finally comes to the steps most familiar with the consumer. The steps most often seen by the consumer are at the points of separation and collection where the post-consumer materials then go for reprocessing or remanufacturing to complete the recycle loop. Not until the material is reused has recycling occurred. The projects discussed in the previous sections consider recycle of materials within the process and waste minimization assessments consider reuse after all source reduction options are exhausted.

Within the area of municipal solid waste, after the waste has been generated and is ready to be managed, recycling and reuse are important options for the integrated solid waste management scheme, particularly for wastes generated by communities. Recycling is a fundamental part of any integrated waste management system, yet only about 10 - 15% of municipal solid waste is currently recycled. Research is needed to identify and demonstrate recycle and reuse techniques that are practical and cost effective in order to increase the percentage of MSW being recycled. Research is also needed for solutions to the institutional and other barriers that block recycling.

One example of a current recycle research project is with the USDA's Forest Products Laboratory where a study is being conducted to investigate the potential for reclaiming newsprint by means of a dry fiberizing process. Another project with the Forest Products Laboratory involves lab and pilot-scale work to develop commercially viable thermoformable composite products using recycled high density polyethylene (HDPE), wood flour, recycled wood fiber, and reclaimed polyester fiber. Results from these research projects will have a positive impact on other pollution prevention programs.

Socioeconomic Research

Socioeconomic research focuses on identifying and evaluating non-technical factors that affect pollution prevention opportunities. Understanding consumer behavior, identifying incentives and social barriers, assessing trends and cycles of production, consumption and use, and developing measurement methods for quantification of pollution prevention are all part of this research area. Waste generators need to understand the full costs associated with the management of wastes before they can realize how pollution prevention can be a part of the integrated waste management solution. Decision makers need the true costs for their waste management alternatives before they can make an informed decision. These costs are not only economic considerations but include a number of non-technological factors such as legal mandates, attitudes, habits, liabilities, and culture. The life cycle of a product should include these criteria to determine production and use for decision makers. A number of decision maker guides will be key tools to be used in the direction and implementation of pollution prevention programs within the integrated waste management system.

Two such research projects are underway with several more in the planning stages. The first project is with the Louisville and Jefferson County Metropolitan Sewer District (MSD) to develop and implement a comprehensive pollution prevention assessment process for public agencies and institutions located in the Louisville Metropolitan area. Under a cooperative agreement with EPA, MSD will evaluate the current status of pollution prevention awareness and activities at a number of State, local, and Federal activities. A pollution prevention assessment process specifically for public agencies will be developed and then tested at the MSD and at other agencies. The widespread use of a uniform procedure will enhance the transfer of information among facilities having common waste management problems and similar pollution prevention opportunities.

A second project in this area is a study to develop a methodology for measuring pollution prevention. Many communities, organizations, government entities, and other waste generators are setting waste reduction and recycling goals without an accepted procedure or methodology. To adequately reflect the progress of pollution prevention and determine success, it is necessary to utilize an appropriate measurement methodology that is acceptable to the private and public sectors. The objective of this initiative is to develop a decision maker's guide for calculating the progress of pollution prevention for hazardous and non-hazardous multi-media waste reduction.

Anticipatory Research Program

Currently the Agency depends on longer term anticipatory research to be conducted at EPA sponsored University Research Centers and Hazardous Substance Research Centers with direction from the ORD. While we recognize the importance of anticipatory research in the pollution prevention research program, limited funds at the Laboratory level do not permit the development of anticipatory research projects at this time. Through committee and advisory board representation, anticipatory pollution prevention research projects are encouraged and are in process at several of these Research Centers.

As described in the Pollution Prevention Research Plan: Report to Congress, the three major areas of long-term research that are essential to a comprehensive pollution prevention research program are:

1. **Anticipating and responding to emerging environmental issues and using pollution prevention approaches to mitigate these issues.**

2. **Evaluating emerging technologies for their potential contribution to pollution prevention and stimulating those that are preferable to existing technologies.**

3. **Evaluating the effectiveness of the Agency's pollution prevention research in meeting changing user information needs.**

Technology Transfer and Technical Assistance

Without technology transfer and technical assistance activities, the pollution prevention research program would have no avenue to disseminate the results. The success of the research components of this program depend on EPA's ability to transfer the technical information to meet the specific needs of waste generators in the public and private sectors. Current projects include the sponsorship of the Pollution Prevention Information Clearinghouse, American Institute for Pollution Prevention, and various workshops and conferences. A successful three-day international conference on pollution prevention was held June 10-13, 1990, in Washington, D.C., with over 1000 attendees from 43 different countries.

The American Institute for Pollution Prevention (AIPP) was established through the University of Cincinnati to provide a liaison channel between EPA and potential implementors of pollution prevention techniques, primarily in industry, that can assist the EPA in improving the quality and cost-effectiveness of its program in the pollution prevention area and that can help generate both private and public sector support for pollution prevention concepts. Some 20 individuals have been appointed to Institute membership. The AIPP is organized into four councils representing economics, education, implementation, and technology. Each of these councils has developed a set of specific 1 to 2 year objectives that includes information transfer and technical assistance.

The objective of the Pollution Prevention Information Clearinghouse (PPIC) is to establish a national information clearinghouse on the subject of pollution prevention. PPIC provides a wide range of information services related to pollution prevention and is meant to serve the needs of Federal, State and local government agencies, large and small businesses, trade associations and others requesting pollution prevention research information. PPIC can be accessed by a toll-free telephone "hotline" or by computer. PPIC contains abstracted and indexed technical information regarding pollution prevention techniques applicable to different industries, manufacturing processes, and types of wastes. It also contains information concerning Federal and state assistance programs, legislative and policy matters, lists of knowledgeable contacts, a schedule of pertinent meetings, and conferences and training sessions. For further information on any aspect of the PPIC, call the PPIC technical support contract telephone number (703) 821-4800.

MUNICIPAL SOLID WASTE AND POLLUTION PREVENTION RESEARCH

The Municipal Solid Waste Subcommittee (MEWS) of the Environmental Engineering Committee (EEC) of the EPA Science Advisory Board (SAB) has prepared a Research-In-Progress report on the Agency's MSW Research Program. The review examined the research areas of source reduction, recycling, thermal destruction, land disposal, and special wastes management. The MSWS recommended priority shifts in the proposed research areas stating that source reduction be the top priority and that recycling research should be coordinated with source reduction research.

The Solid Waste Dilemma: An Agenda for Action describes the massive MSW problem and the recommendations of integrated waste management favoring source reduction and recycling as the preferred waste management options. To meet the national goals and problems associated with MSW, a strong pollution prevention (source reduction and recycling) research program is needed to substantially reduce the generation of wastes. The ORD is supporting research in all areas related to pollution prevention of MSW and has discussed many of these projects in earlier portions of this paper.

MSW source reduction projects include product research, plastic degradability studies, safe substitutes research, and life cycle analysis. The MSW Source Reduction Research Program has the four following objectives:

1. To establish models for assessing environmentally preferable products.

2. To identify and evaluate the pollution generation characteristics of both existing and new products and of changing product-use patterns.

3. To develop a methodology for measuring the impact and benefits of source reduction.

4. To identify opportunities for source reduction and to conduct source reduction opportunity assessments for a variety of waste streams.

MSW recycling projects include waste separation studies, recycle verses virgin materials studies, technology development and demonstration for recovering materials for reuse, and a compilation of alternative recycling operation options. The MSW Recycling Research Program objectives are:

1. To assess the health and environmental risks associated with recycling and resource recovery operations.

2. To develop, demonstrate, and evaluate recycling and resource recovery techniques and technologies.

3. To identify and evaluate innovative waste separation mechanisms that facilitate the separation of recyclable materials from the waste stream.

FUTURE RESEARCH PLANS

A July 5, 1990, memorandum from the EPA Assistant Administrator for Research and Development shares a vision statement with all ORD employees that EPA must become a science agency as well as a regulatory agency. The statement goes on to set six goals for ORD for the next 2 - 3 years and one of the goals is for pollution prevention research. The goal is as follows: " ORD should become the leading institution in the United States for supporting the development of new methodologies and technologies for preventing or reducing volumes of harmful pollutants and providing that information to the user community."

Currently a Pollution Prevention Strategic Plan is being developed at the Laboratory level to make the link from planning to projects to outputs to research needs to participants and clients. This five year plan clearly emphasizes contemporary and future research needs and adds specificity to the Pollution Prevention Research Plan: Report to Congress and the "Municipal Solid Waste Research Agenda".

The EPA Science Advisory Board (SAB) in their report Future Risk: Research Strategies for the 1990's recognized pollution prevention as a valid approach to environmental protection and focuses on the importance of pollution prevention as a cost effective alternative to "end-of-pipe" pollution control. The SAB also noted that EPA is the only entity that is likely to exert leadership in conducting the basic environmental research needed to address future environmental issues and cross-media problems.

There is no doubt that pollution prevention research is supported by the Agency management. The Pollution Prevention Research Program has achieved early success evaluating and demonstrating pollution prevention techniques and technologies. Each of the projects and programs described in this paper is part of EPA's overall research program for the 1990's. A solid foundation built with quality science and careful planning is the basis for future pollution prevention research within the Agency.

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